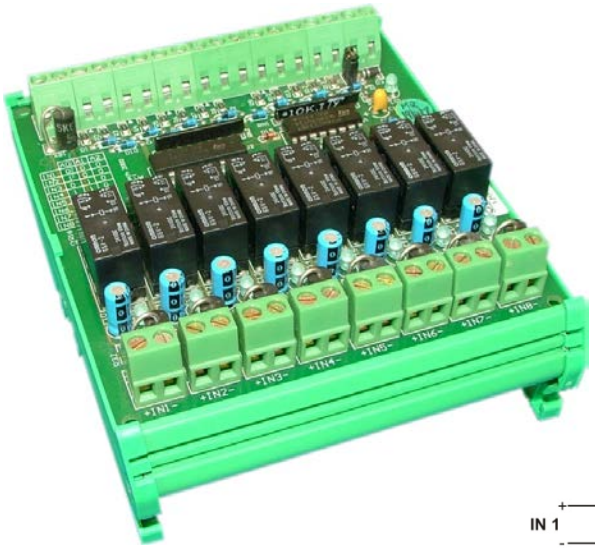
# Process Signal Multiplexer - 8 to 1 User Manual

## Description

The Process Signal Multiplexer provides a low cost way of selecting one of eight (or more) analogue signals. Typically, this could be used to switch multiple sensors into a transmitter or one of many transmitter outputs into a single analogue PLC input.



High quality, signal grade relays, rated for a minimum of 15 million operations are used to select the input signals.

*Four versions provide suitable inputs for:*

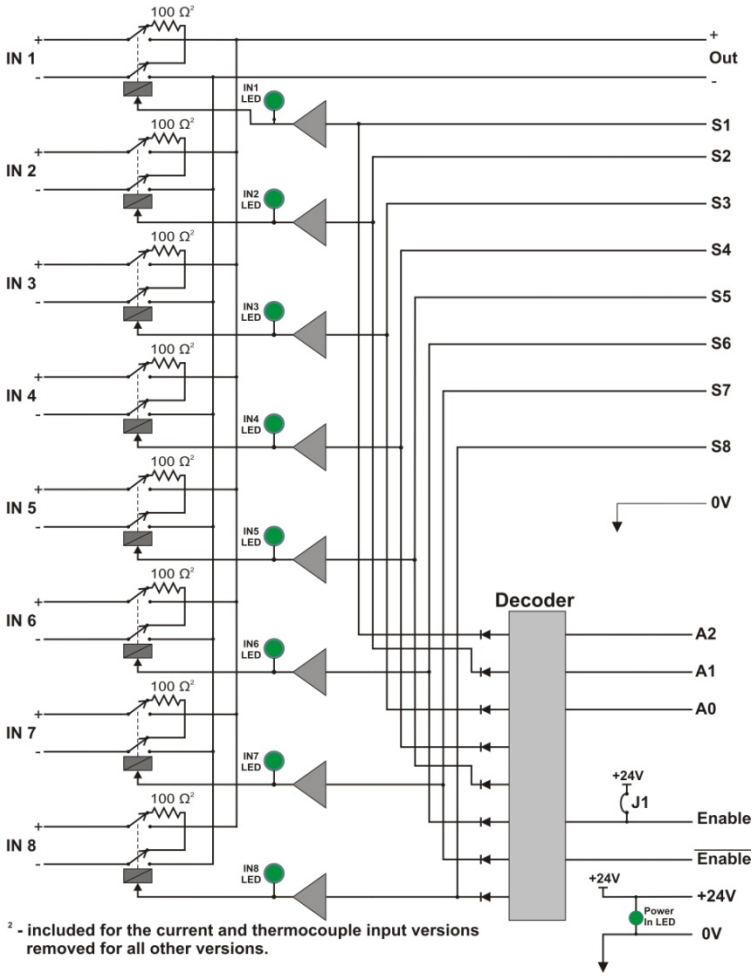
- Thermocouples,
- resistance sensors (pT100/pT1000),
- voltage and
- current.

Two input selection options are available, either eight digital inputs switching each relay separately or using only three digital inputs with the binary equivalent used to switch the required input so that only three digital inputs are required.

Two enable inputs are provided so for flexibility implementing other selection options. An example could be controlling two multiplexers with four digital inputs.

The digital inputs required are from 16 to 30 VDC and LEDs indicate which input is active. Multiple multiplexers can be used to switch any number of sensors or analogue inputs. It is best to order the correct unit for your type of inputs so that the input adjustments are made for you before delivery. See the part numbering information for details to order the correct device for your application.

The input relay selection can be made using either the direct acting S1 through S8 inputs or the decoded A0, A1 and A2 inputs with the ENABLE controls.



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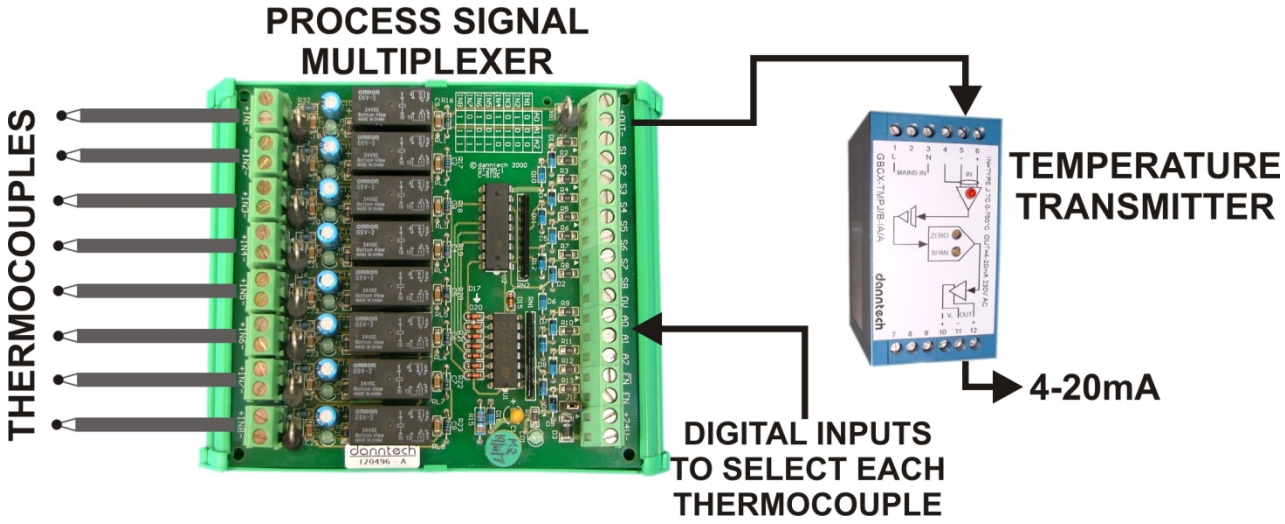
## Applications

The drawing below illustrates an application where eight thermocouples or eight pT100s can be scanned into a single transmitter using a PLC or similar type controller.

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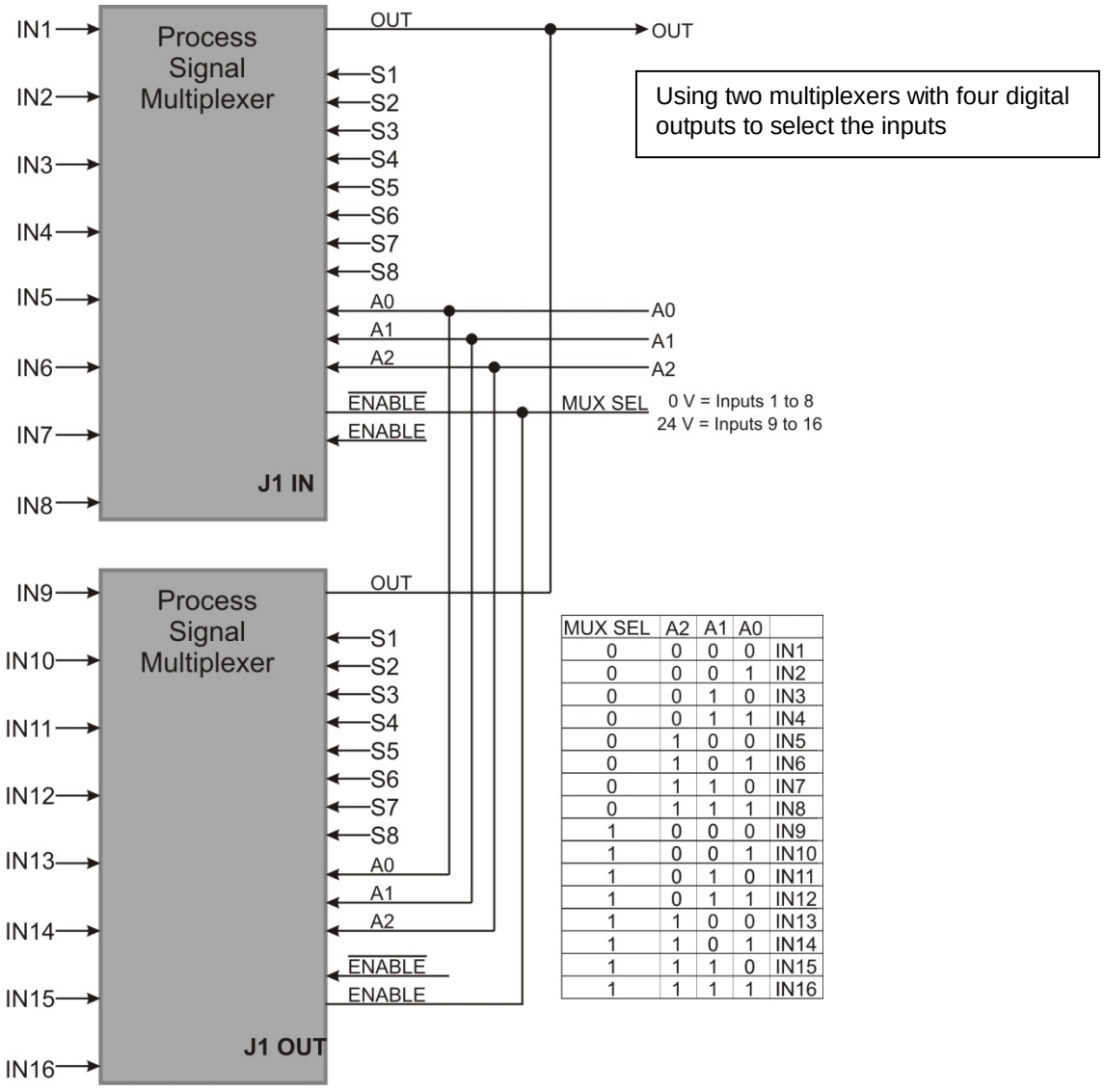


| MUX SEL | A2 | A1 | A0 | |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | IN1 |
| 0 | 0 | 0 | 1 | IN2 |
| 0 | 0 | 1 | 0 | IN3 |
| 0 | 0 | 1 | 1 | IN4 |
| 0 | 1 | 0 | 0 | IN5 |
| 0 | 1 | 0 | 1 | IN6 |
| 0 | 1 | 1 | 0 | IN7 |
| 0 | 1 | 1 | 1 | IN8 |
| 1 | 0 | 0 | 0 | IN9 |
| 1 | 0 | 0 | 1 | IN10 |
| 1 | 0 | 1 | 0 | IN11 |
| 1 | 0 | 1 | 1 | IN12 |
| 1 | 1 | 0 | 0 | IN13 |
| 1 | 1 | 0 | 1 | IN14 |
| 1 | 1 | 1 | 0 | IN15 |
| 1 | 1 | 1 | 1 | IN16 |



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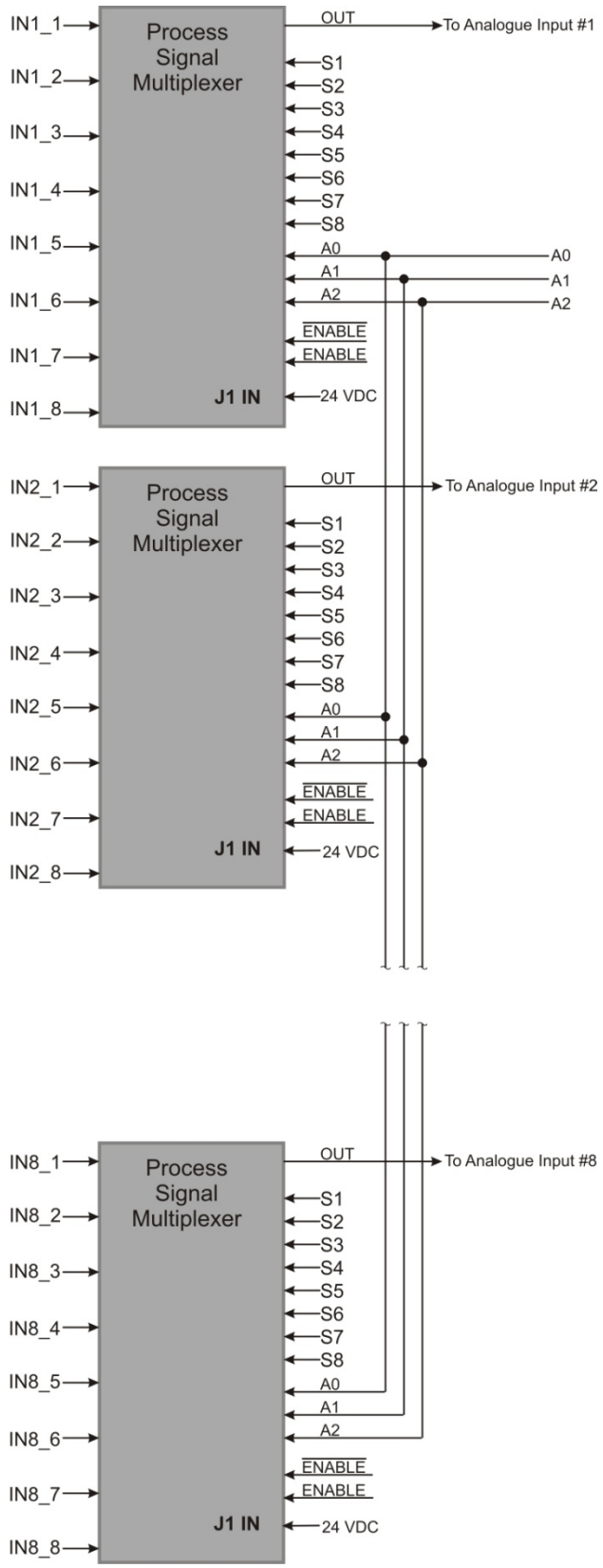
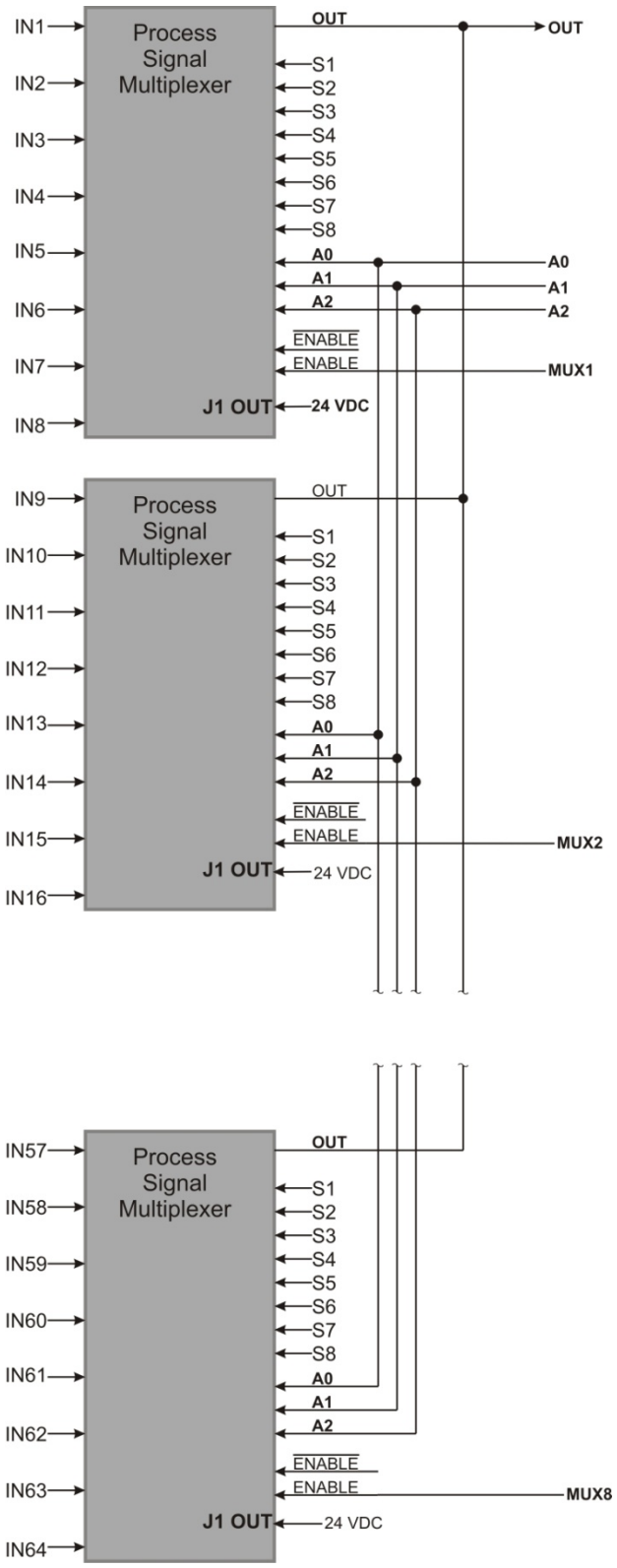
| Using eight multiplexers to expand an eight analogue input system to 64 analogue inputs by using 11 digital outputs for multiplexer selection and input addressing. | Using multiple multiplexers with three digital outputs for the address lines and a digital output to select each individual multiplexer. |
|---|---|
|  |  |





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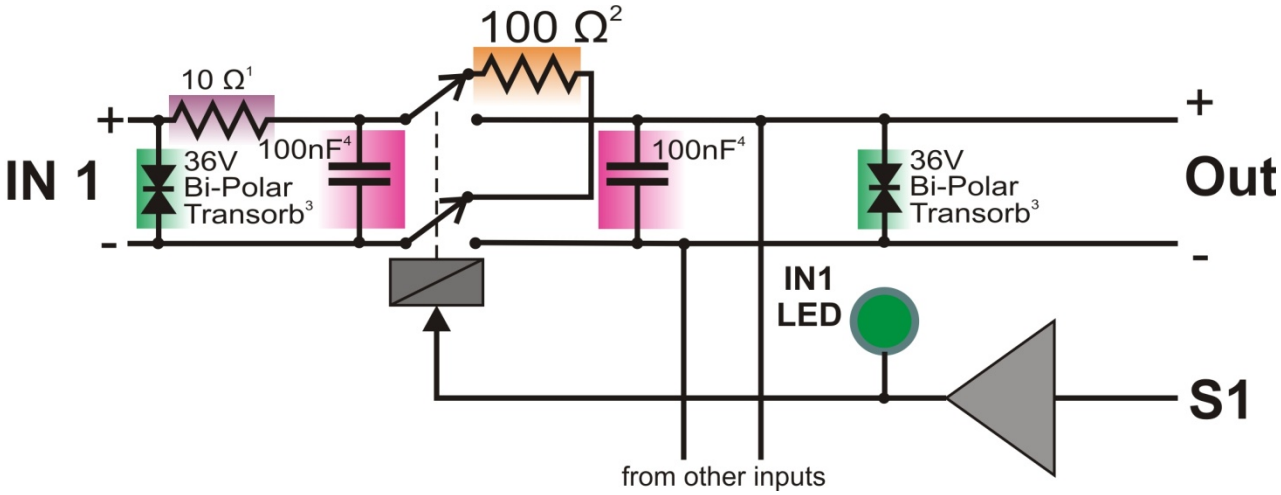
## Circuit Configurations

The general circuit diagram for each input is shown below. However for each input type some of the protection components need to be removed as they can affect the measurement.




| | Input Type → | Thermocouple | Resistance (pT100/pT1000) | Current | Voltage |
|---|---|---|---|---|---|
| | | **PL-MUX8-1/TC/C** Process Signal Mux 8 to 1, TC Input, 24VDC | **PL-MUX8-1/R/C** Process Signal Mux 8 to 1, R Input, 24VDC | **PL-MUX8-1/I/C** Process Signal Mux 8 to 1, I Input, 24VDC | **PL-MUX8-1/V/C** Process Signal Mux 8 to 1, V Input, 24VDC |
| 1 | 10 Ω series resistor for signal filtering/noise limiting. | Left in. No effect with high Z transmitter input. Good for filtering. | Removed. Will add measurement error. (R32 through to R39 – out, replace with 0R or solder link) | Left in. Little effect on current loop. Good for filtering. | Left in. No effect with high Z transmitter input. Good for filtering. |
| 2 | 100 Ω termination resistor for current loop continuity when the input is NOT selected (i.e. relay is in the OFF state). | Left in. No effect on TC not selected. | Left in. No effect on resistance not selected. | Left in. Provides realistic loop resistance when the input is not selected. | Removed to avoid heating when voltage input is not selected. (R16 through to R23 – out) |
| 3 | Transorbs for spike protection which can occur in current loop circuits. Reduces voltage surges due to switching in constant current circuits. Extends relay contact life. | Removed to avoid leakage which can cause inaccuracy. (XB1 through to XB9 - out) | Removed to avoid leakage which can cause inaccuracy. (XB1 through to XB9 out) | Left in. Spike protection during switching. Best for relay contact protection. | Left in. Spike protection during switching. Best for relay contact protection. |
| 4 | 100 nF capacitors for reduction of switching noise and signal filtering. (see note below) | Left in. Reduces noise but may slow down response. | Left in. Reduces noise but may slow down response. | Left in. Reduces noise but may slow down response. | Left in. Reduces noise but may slow down response. |

It may be desirable to remove C2 through to C9 (100nF capacitors after the relay on the right of the relay in the circuit diagram above) to improve response time when switching channels and also C18 through to C25 (100nF capacitors before the relay on the left of the relay in the circuit diagram above) to improve individual channel step responses, this will depend upon the application.



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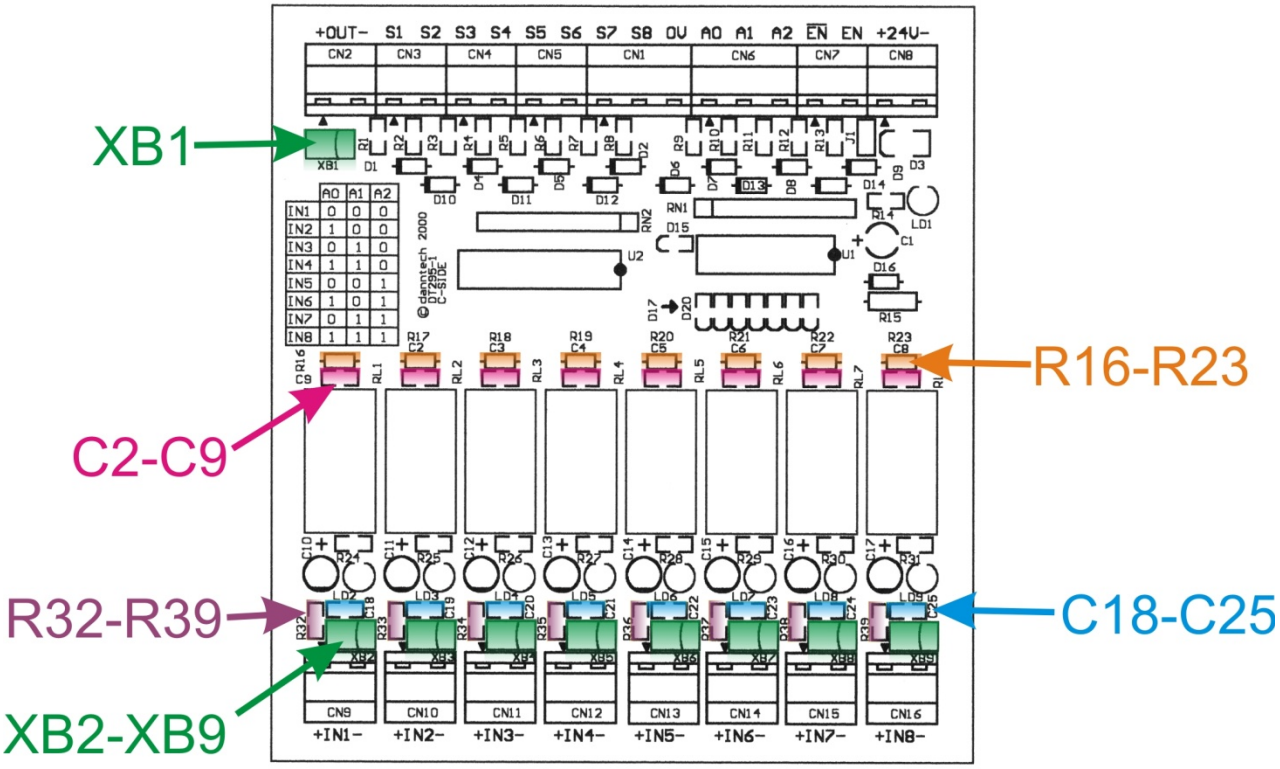
## Component Layout


XB1
C2-C9
R32-R39
XB2-XB9
R16-R23
C18-C25
+OUT- S1 S2 S3 S4 S5 S6 S7 S8 0V A0 A1 A2 EN EN +24V-
CN2 CN3 CN4 CN5 CN1 CN6 CN7 CN8
CN9 CN10 CN11 CN12 CN13 CN14 CN15 CN16
+IN1- +IN2- +IN3- +IN4- +IN5- +IN6- +IN7- +IN8-

## Signal Switching Effects

There are some things to keep in mind when switching process signals either as inputs from sensors or outputs of transmitters:

Process signal transmitters react in various ways to a fluctuating (switching) input signal. For example in the case of a thermocouple input temperature transmitter, the switching of the input signal may be detected as a brief “open sensor” event by a transmitter. The transmitter may then see this as a TC “burnout” and output a fault level signal for a while (typically 2 or 22 mA), until a stable input is returned. So in this case one would need to either disable this feature in the transmitter or allow enough time for the transmitter output signal to settle.

In the case of selecting various loop currents which are outputs of process signal transmitters, when the output circuit of such a transmitter goes open circuit, however briefly, the loop voltage may spike to try and maintain the loop current. This effect will depend upon the reaction time of the output circuit of the transmitter and can be reduced or limited by the use of transorbs and basic filtering. Again, allowing enough settling time between signal switching is important. The termination resistors used for the current input options try to reduce this effect so that the transmitter output “sees” a fairly constant load resistance except of course during the brief switching period.

Another application we have had experience with is where a multiplexer is used to monitor the individual cell voltage in a battery. Since each input is at a different potential and the battery is capable of providing large currents if there is any switching overlap, whatsoever there could be voltage spikes at the output and any current flowing can damage the relay contacts. If the relay contacts are damaged, incorrect measurements can result or complete input failure. To avoid this one should allow some inter-switching time, this is where none of the relays are selected. This is fairly easy to do when using the individual selection inputs S1 through S8 but more difficult when using the decoded inputs A0, A1 and A2. In the case of the decoded inputs being used, we recommend using the ENABLE input to provide the inter-switching delay. Basically the procedure could be – ENABLE=low; set up the address of the input required; wait a short while (0.5 s); ENABLE=high; wait a short while (0.5 s) for measurement to settle; read the analogue input; then repeat.



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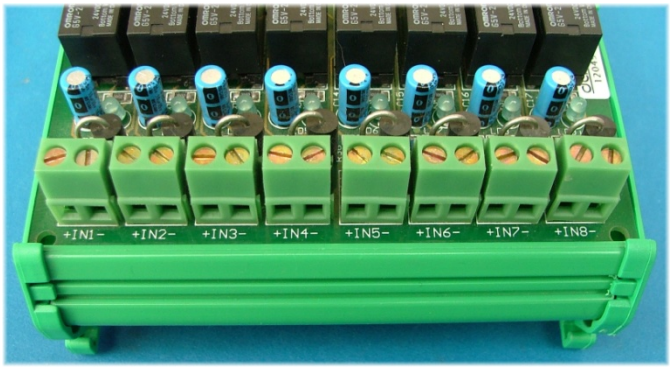
It may be desirable to remove C2 through to C9 (100nF capacitors after the relay on the right of the relay in the circuit diagram above) to improve response time when switching channels and also C18 through to C25 (100nF capacitors before the relay on the left of the relay in the circuit diagram above) to improve individual channel step responses, this will depend upon the application.

## Connections

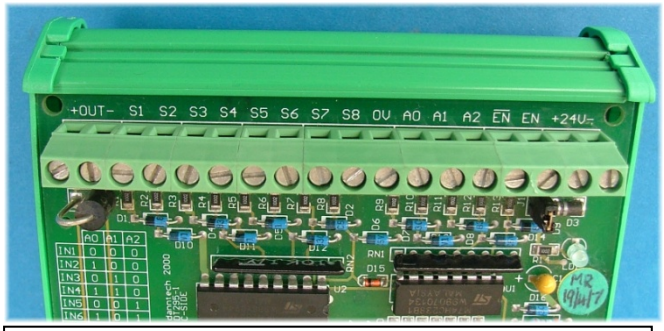
***Signal Inputs:***

| Terminal Marking | Description |
|---|---|
| -IN1 | Signal Input 1 –ve (or 0V) |
| +IN1 | Signal Input 1 +ve |
| -IN2 | Signal Input 2 –ve (or 0V) |
| +IN2 | Signal Input 2 +ve |
| -IN3 | Signal Input 3 –ve (or 0V) |
| +IN3 | Signal Input 3 +ve |
| -IN4 | Signal Input 4 –ve (or 0V) |
| +IN4 | Signal Input 4 +ve |
| -IN5 | Signal Input 5 –ve (or 0V) |
| +IN5 | Signal Input 5 +ve |
| -IN6 | Signal Input 6 –ve (or 0V) |
| +IN6 | Signal Input 6 +ve |
| -IN7 | Signal Input 7 –ve (or 0V) |
| +IN7 | Signal Input 7 +ve |
| -IN8 | Signal Input 8 –ve (or 0V) |
| +IN8 | Signal Input 8 +ve |




***Output and Controls:***

| Terminal Marking | Description |
|---|---|
| -OUT | Selected Signal Output –ve (or 0V) |
| +OUT | Selected Signal Output +ve |
| S1 | Direct selection for Input 1 |
| S2 | Direct selection for Input 2 |
| S3 | Direct selection for Input 3 |
| S4 | Direct selection for Input 4 |
| S5 | Direct selection for Input 5 |
| S6 | Direct selection for Input 6 |
| S7 | Direct selection for Input 7 |
| S8 | Direct selection for Input 8 |
| 0V | Common 0V for all control inputs (connected to -24V) |
| A0 | Decoded input 0 |
| A1 | Decoded input 1 |
| A2 | Decoded input 2 |
| $\overline{EN}$ | Not ENABLE – when high all relays are disabled |
| EN | ENABLE – When low all relays are disabled. Must be high (can be via J1) for any inputs to be selected. |
| +24V | Power supply input - +24 VDC |
| -24 V | Power supply 0V (connected to 0V) |




| A2 | A1 | A0 | Enable | Not Enable | |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | IN1 |
| 0 | 0 | 1 | 1 | 0 | IN2 |
| 0 | 1 | 0 | 1 | 0 | IN3 |
| 0 | 1 | 1 | 1 | 0 | IN4 |
| 1 | 0 | 0 | 1 | 0 | IN5 |
| 1 | 0 | 1 | 1 | 0 | IN6 |
| 1 | 1 | 0 | 1 | 0 | IN7 |
| 1 | 1 | 1 | 1 | 0 | IN8 |
| X | X | X | 0 | X | All off-can be controlled by S1-S8 |
| X | X | X | X | 1 | All off-can be controlled by S1-S8 |

*X* = don't care

Note that the enable inputs only apply to the decoded inputs (A0 to A2), the S1 to S8 inputs are not affected by the ENABLE control inputs.



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# Specifications

**Input Selection**
Individual input selection using eight digital inputs S1 to S8. Multiplexed relay selection using three digital inputs (A0, A1 and A2) with decoder and enable inputs.

Selection inputs S1 to S8 have an input impedance of 20 kΩ (1.1 mA at 24 V, 2.2 mA at 12 V). Decoded selection inputs A0 to A2 have input impedance of 10 kΩ (2.2 mA at 24 V, 4.4 mA at 12 V). Enable inputs have an input impedance of 10 kΩ (2.2 mA at 24 V, 4.4 mA at 12 V). LED indication of selected input.

When using the individual input selection inputs S1 to S8, the enable controls cannot be used and **J1 must be removed** to disable the decoded selection inputs. Either input type can be used by connecting to the appropriate terminals - J1 must be removed for direct S1 to S8 control.

**Enable Control Inputs**
The ENABLE input is pulled high by J1, so if J1 is inserted then the decoded selection inputs are enabled. The NOT ENABLE input is pulled low internally.

**Inputs**
Four versions provide suitable input configurations for thermocouples, resistance sensors (pT100/pT1000), voltage and current inputs.
Maximum input voltage ±30 V, maximum input current 30 mA (with 100 Ω termination resistors installed).

**Relays**
Fully sealed, low signal relays, gold plated contacts.
Response time approximately 10 mSecs.
Contact rating 2 A at 30 VDC, 500 mA at 125 VAC.
Life expectancy more than 15 million operations.
Isolation greater than 500 VAC.
Omron Type G5V-2 plug-in fitting so they can be replaced if necessary.
Minimum load 10 µA, 10 mV DC.

**LED Indication**
Green LED indication of power supply and green LED indication of active/selected input.

**Isolation**
Galvanic isolation between unselected inputs > 500 VAC.

**Power**
24 VDC (±10%) auxiliary power supply at approximately 50 mA.

**Temperature**
Operating temperature -10°C to 60°C.
Storage temperature -20°C to 80°C.

**Mechanical**
Screw terminals to accommodate wire sizes up to 1.5 $mm^2$.
Module dimensions - 103 x 126 x 50 mm (width x length top to bottom x height off DIN rail).
Module mass – 200 g.
Package dimensions - 260 x 170 x 80 mm (length x width x height)
Package mass – 400 g.



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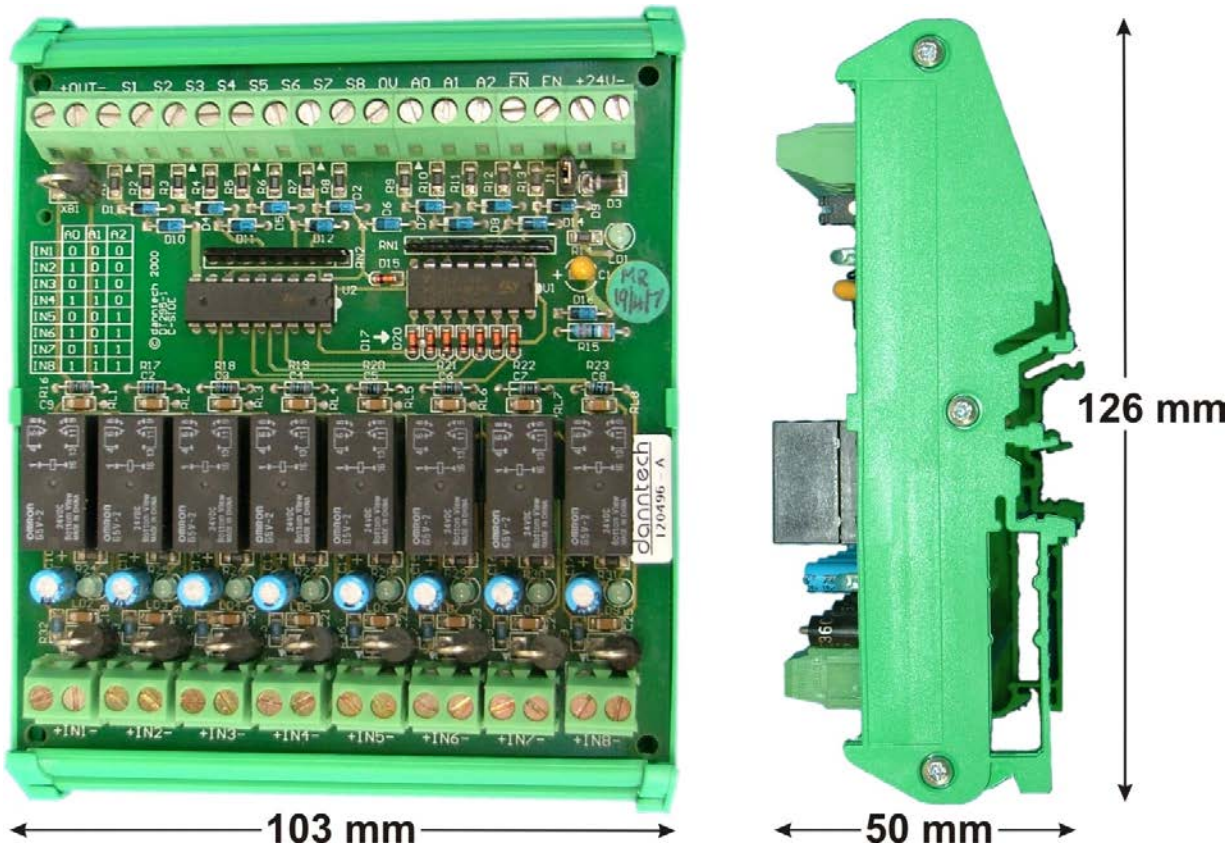


## Part Numbering

**PL-MUXn-m/tt/p  Process Signal Mux 8 to 1, tt Input, 24VDC**

n = Number of Inputs:

8 = Eight

m = Style:

O = Open DIN Rail Mounting

tt = Input Type:

TC = Thermocouple
R = resistance or pT100/pT1000
V = voltage
I = current

p = Power Supply:

C = 24 VDC
D = 12 VDC

***Part Numbering:***

| | |
|---|---|
| PL-MUX8-1/TC/C | Process Signal Mux 8 to 1, TC Input, 24VDC |
| PL-MUX8-1/R/C | Process Signal Mux 8 to 1, R Input, 24VDC |
| PL-MUX8-1/I/C | Process Signal Mux 8 to 1, I Input, 24VDC |
| PL-MUX8-1/V/C | Process Signal Mux 8 to 1, V Input, 24VDC |

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